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10/26/99

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PATENT

Docket No. D-349

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant - LUI, et al.	Information Disclosure Statement
Title - Gaussian Minimum Shift Keying (GMSK) Precoding Communication Method	Los Angeles, California Date: 8/31/99 Commissioner of Patents and Trademarks Washington, DC, 20231

Dear Sir:

INFORMATION DISCLOSURE STATEMENT

Applicant hereby discloses information believed relevant to the examination of the present application.

Reference 1, P. Laurent, "Exact Approximation Construction of Digital Phase Modulations by Superposition of Amplitude Modulated Pulses (AMP)," IEEE Transactions on Communications, VOL. 34, NO. 2, February, 1986.

Laurent teaches the expansion of the complex envelop of 2-ary continuous phase modulation (CPM) signals as a sum of a sequence of amplitude modulated pulses. This expansion has components that can be isolated by respective match filters providing respective partial representation of the signal for subsequent Viterbi decoding. The present invention relies upon Laurent filtering to isolate a principal component of the Laurent expansion in order to achieve absolute phase demodulation, not suggested by Laurent.

Reference 2, U. Megali and M. Morelli, "Decomposition of M-ary CPM Signals into PAM Waveforms," IEEE Transactions on Communications, VOL. COM-41, NO. 5, September 1995.

Magalie teaches a generalized approach to higher order alphabets of CPM signals, such as 4-ary and higher alphabets. The present invention can also be extended to higher order alphabets to the more generalize expansion.

Reference 3, G. Kaleh, "Simple Coherent Receivers for Partial Response Continuous Phase Modulation," IEEE Journal On Selected Areas in Communications, VOL. 7, NO. 9, December 1989.

Kaleh teaches that simple receivers structures for partial response CPA signal can be developed from the Laurent signal representation. Kaleh teaches the use of differential decoding in combination with a simple Laurent expansion. The present invention proceeds directly contrary to Kaleh, and implements data precoding

to achieve absolute phase demodulation in the Laurent filters to thereby eliminate the need for differential decoding, while offering improved performance.

Lui, GMSK Modulation, 6-18-97, Working Meeting and Advanced Disclosure, The Aerospace Corporation.

Lui is not considered prior art but only a limited distributed advanced disclosure in connection with experimental preliminary work by the inventors at the time of conception in support of Government contracts. This information was disclosed to Government contractors as experimental work under process at a technical exchange meeting having a limited number of contractor attendees in addition to Government employees as customers of the assignee. This advanced publication was disclosed to a small number of persons, less than twenty, from less than three contractor companies. Though there was no confidentiality agreement in place, these contractors typically keep these advanced disclosures confidential as part of experimental development, dealing in good faith, in a common effort to serve the interests of the U.S. Government.

This work mentions first conceptions of the 2-ary precoding process. Only equation models were presented and no specific precoding tables were disclosed. The alternative sign -1^k in the 2-ary equation can be done at the transmitter or receiver without a lost of generality. This -1^k sign attribute of the dual 2-ary precoding methods was not disclosed at the working meeting. The

equations of $\{\alpha_n\}d_{n-1}d_n$ were not disclosed and is believed necessary for realizing the specific 2-ary precoding table necessary for implementing a reduction to practice. Lui is believed to be nonenabling. No information at all was presented for the 4-ary precoding method as it had not yet been conceived in furtherance of the experimental development.

Remarks

The cited Laurent, Magalie, and Kaleh references do not teach nor suggest the use of precoding to achieve absolute phase demodulation to thereby eliminate the need for differential decoding in a CPM GMSK modulation communication system.

The limited advanced disclosure of Lui to Government contractors in furtherance of Government business, as the Government being assignee's primary customer, existed under an implied condition of confidentiality. The advanced disclosure is not considered a public disclosure. The advanced disclosure is not considered an enabling disclosure of the 2-ary precoding table. The advanced disclosure was in furtherance of experimental development, ultimately leading to the preferred 4-ary precoding table. The claimed 2-ary dual precoding scheme was not disclosed. Even if one understood the 2-ary case, including the table and could generate the 4-ary equations, the actual precoding specified by the 4-ary table would not be obvious.

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Precoding algorithm is developed for specific values of the modulation index. For the 2-ary case, there is only one preferred value of the modulation index that is 1/2, dictating the 2-ary precoding table values. For the 4-ary case, the modulation index can be either 1/4 or 3/4, and does not dictate the 4-ary precoding table. As such, the modulation index precoding table is not applicable to an arbitrary modulation index.

For the 4-ary case, one skilled in the art must first search for a suitable modulation index and then attempt to discover by educated guesses what precoding table values might work. This process is essentially a triple guessing game, including the number of symbol used, multiplied the number of possible modulation indices, multiplied by the number of possible precoder tables. The number of possible modulation indices is infinite because any arbitrary fraction between zero and one may be used, even though the selection of common indices are typically 1/2, 1/3, 1/4, 1/5, 1/6, 1/8, 1/9, or 1/10 with more than 100 possible values that have been used or suggested in the art. The number of possible symbols used could also be infinite and is specified in whole numbers typically between 1 and 1024. The number of possible distinct 4-ary tables using four values (±1 and ±3) is 4 to the power of 4 to the power four times the number of symbols, 1000. Hence, the triple guessing game offers a vast number of choices, and was found by the inventors essentially through trial and error and educated guesses. Through trial and error and educated guesses the inventors have discovered a particular combination of the number of

symbols, the modulation indexes and a particular 4-ary table, that functions to meet the objects of the invention.

The prior art did not teach nor suggest data precoding to achieve absolute phase demodulation in a CPM receiver. The advanced disclosure was in the nature of experimental effort, and is not considered a public disclosure, nor considered an enabling disclosure. Even if found to be public, enabling and nonexperimental, the advanced disclosure did not teach nor suggest the flip flop sign attribute of the 2-ary case, nor the 4-ary selected modulation indices and respective precoding tables. Allowance of the claims is requested.

Date: 8/31/99

Respectfully Submitted

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